

CLAIMS

What is claimed is:

1. A polymer electrolyte membrane-electrode assembly for a fuel cell comprising:

a first electrode and a second electrode; and

a polymer electrolyte membrane interposed between said first and second electrodes,

wherein each of said first and second electrodes comprises a catalyst layer in contact with said polymer electrolyte membrane and a gas diffusion layer in contact with said catalyst layer, and

wherein said polymer electrolyte membrane comprises electronically insulating spacer members that separate the respective gas diffusion layers of the first and second electrodes.

2. The polymer electrolyte membrane-electrode assembly in accordance with claim 1, wherein said spacer members comprise an electrically insulating material.

3. The polymer electrolyte membrane-electrode assembly in accordance with claim 1, wherein said spacer members comprise a polymer electrolyte having a higher modulus of elasticity than a material of said polymer electrolyte membrane.

4. The polymer electrolyte membrane-electrode assembly in accordance with claim 1, wherein the gas diffusion layer of at least one of said first and second electrodes comprises projections on a surface that faces said polymer electrolyte membrane and an electronically insulating layer that coats said projections.

5. The polymer electrolyte membrane-electrode assembly in accordance with claim 4, wherein said insulating layer comprises an electrically insulating inorganic material and a polymer resin.

6. A method for manufacturing a polymer electrolyte membrane-electrode assembly for a fuel cell, comprising the steps of:

disposing electronically insulating particles over a face of a polymer electrolyte membrane;

providing a first electrode to said face of said polymer electrolyte membrane having said particles; and

providing a second electrode to another face of said polymer electrolyte membrane.

7. A method for manufacturing a polymer electrolyte membrane-electrode assembly for a fuel cell, comprising the steps of:

applying a polymer electrolyte solution onto a surface of a first polymer electrolyte membrane;

disposing electronically insulating particles on said surface applied with said polymer electrolyte solution;

drying said polymer electrolyte solution to form a composite polymer electrolyte membrane comprising the first polymer electrolyte membrane and a second polymer electrolyte membrane that contains said particles;

applying a first electrode to one face of said composite polymer electrolyte membrane; and

applying a second electrode to another face of said composite polymer electrolyte membrane.

8. A method for manufacturing a polymer electrolyte membrane-electrode assembly for a fuel cell, comprising the steps of:

disposing electronically insulating particles on a face of a first polymer electrolyte membrane;

layering a second polymer electrolyte membrane to said face of said first polymer electrolyte membrane having said particles to form a composite polymer electrolyte membrane;

applying a first electrode to one face of said composite polymer electrolyte membrane; and

applying a second electrode to another face of said composite polymer electrolyte membrane.

9. A method for manufacturing a polymer electrolyte membrane-electrode assembly for a fuel cell, comprising the steps of:

applying a solution containing a multi-functional monomer capable of thermal polymerization or photo polymerization and a polymer electrolyte in an island form to a face of a first polymer electrolyte membrane;

performing at least one of photo-irradiating and heating said solution applied to said face of said first polymer electrolyte membrane to form polymer electrolyte particles having a high modulus of elasticity on said first polymer electrolyte membrane;

applying a polymer electrolyte solution onto said face of said first polymer electrolyte membrane having said particles;

drying said applied polymer electrolyte solution to form a composite polymer electrolyte membrane comprising said first polymer electrolyte membrane and a second polymer electrolyte membrane that contains said particles; and

applying a first electrode to one face of said composite polymer electrolyte membrane; and

applying a second electrode to another face of said composite polymer electrolyte membrane.

10. A polymer electrolyte membrane electrode assembly for a fuel cell, comprising:

a polymer electrolyte membrane;

an anode-side electrode applied to a first face of the polymer electrolyte membrane;

a cathode-side electrode applied to a second face of the polymer electrolyte membrane that opposes the first face; and

a plurality of electronically insulating members disposed between the anode-side and cathode-side electrodes that separates the anode-side and cathode-side electrodes in a region of the electronically insulating members.

11. The polymer electrolyte membrane electrode assembly of claim 10, wherein the anode-side and cathode-side electrodes each comprise a catalyst layer.

12. The polymer electrolyte membrane electrode assembly of claim 10, wherein the electronically insulating members comprise an electrically conductive particle coated with an electrically insulating material.

13. The polymer electrolyte membrane electrode assembly of claim 10, wherein the electronically insulating members comprise a polymer electrolyte material having a higher modulus of elasticity than that of the polymer electrolyte membrane.

14. The polymer electrolyte membrane electrode assembly of claim 10, wherein the thicknesses of the electronically insulating members are in the range of about 5 to about 20 μm .

15 A polymer electrolyte membrane electrode assembly, comprising:

a polymer electrolyte membrane;

an anode-side electrode joined to a first face of the polymer electrolyte membrane;

a cathode-side electrode joined to a second face of the polymer electrolyte membrane that opposes the first face;

at least one of the anode-side and cathode-side electrodes comprises a gas diffusion layer having projections facing the polymer electrolyte membrane; and

an electronically insulating layer that is disposed between the anode-side and cathode-side electrodes that separates the anode-side and cathode-side electrodes in a region of the electronically insulating layer and that coats said projections facing the polymer electrolyte membrane.

16. The polymer electrolyte membrane electrode assembly of claim 15, wherein the electronically insulating layer comprises a polymer resin.

17. The polymer electrolyte membrane electrode assembly of claim 16, wherein the electronically insulating layer further comprises inorganic insulating material.

18. The polymer electrolyte membrane electrode assembly of claim 15, further comprising a plurality of electronically insulating members that are disposed between the anode-side and cathode-side electrodes and that separate the anode-side and cathode-side electrodes in a region of the electronically insulating members.

19. The polymer electrolyte membrane electrode assembly of claim 18, wherein the electronically insulating members are particles which have thicknesses in a range of about 5 μm to about 20 μm .

20. A method for manufacturing a polymer electrolyte membrane electrode assembly comprising a polymer electrolyte membrane, an anode-side electrode joined to a first face of the polymer electrolyte membrane, a cathode-side electrode joined to a second face of the polymer electrolyte membrane that opposes the first face, at least one of the anode-side and cathode-side electrodes comprises a gas diffusion layer having projections facing the polymer electrolyte membrane, and an electronically insulating layer that is disposed between the anode-side and cathode-side electrodes that

separates the anode-side and cathode-side electrodes in a region of the electronically insulating layer and that coats said projections facing the polymer electrolyte membrane, said method comprising forming said electronically insulating layer on said projections by the steps of:

forming an electronically insulating film on a substrate;
placing said electronically insulating film formed on said substrate on one face of said gas diffusion layer; and
transferring said electronically insulating film to said projections on the surface of the gas diffusion layer.

21. The method according to claim 20, wherein said step of forming said electronically insulating film comprises coating a mixture of a fluid or liquid resin material and an inorganic electronically insulating material or a dispersion of inorganic particles in a dispersion medium onto said substrate.

22. The method according to claim 20, wherein said transferring step comprises drying or curing said electronically insulating and then transferring said electronically insulating film to said gas diffusion layer by compression bonding or roller pressing.

23. The method according to claim 20, wherein said transferring step comprises transferring said electronically

insulating film to said gas diffusion layer by compression bonding or roller pressing and then drying or curing said electronically insulating film to provide said electronically insulating layer.

24. The method according to claim 20, wherein said substrate comprises a film of polypropylene or polyethylene terephthalate.

25. A method for manufacturing a polymer electrolyte membrane electrode assembly comprising a polymer electrolyte membrane, an anode-side electrode joined to a first face of the polymer electrolyte membrane, a cathode-side electrode joined to a second face of the polymer electrolyte membrane that opposes the first face, at least one of the anode-side and cathode-side electrodes comprises a gas diffusion layer having projections facing the polymer electrolyte membrane, and an electronically insulating layer that is disposed between the anode-side and cathode-side electrodes that separates the anode-side and cathode-side electrodes in a region of the electronically insulating layer and that coats said projections facing the polymer electrolyte membrane, said method comprising forming said electronically insulating layer on said projections by the steps of:

applying a coating material including an electronically insulating material on said projections; and

curing said coating material.

26. The method according to claim 25, wherein said applying step comprises a printing method using a thick metal mask and a doctor blade.

27. The method according to claim 25, wherein said curing step comprises drying said coating material, heating coating material, or radiating said coating material with ultraviolet rays or radioactive rays.

28. The method according to claim 25, wherein said coating material comprises a mixture of a fluid or liquid resin material and an inorganic electronically insulating material or a dispersion of inorganic particles in a dispersion medium onto said substrate.